

## REMARKS

The following statements are the Patent Examiner's (PE's) July 17, 2003 first office action comments and the applicant's responses to his comments.

U.S. Patent 3,941,874 - Thomas F. Payne  
RECOVERY OF ALUMINUM FLUORIDE - March 2, 1976

1. PE: "Payne teaches the process of reacting a metal oxide, eg. alumina, with an aqueous HF solution to form a solution, drying the solution and recovering a metal hydroxy-fluoride, eg. aluminum hydroxide fluoride, which was then calcined to form aluminum fluoride (see cols. 6-7). During the calcinations of aluminum hydroxide fluoride an intermediate product of aluminum oxyfluoride would form prior to the formation of aluminum fluoride."

Applicant: It is the alumina hydrates that react with the aqueous fluoride solution that causes the formation of the aluminum hydroxide fluoride hydrate; (2) neither Payne's chemical nor X-ray analyses identified "an intermediate product of aluminum oxyfluoride" formed, during the calcinations of aluminum hydroxide fluoride hydrate (col.6, lines 28-37 and 44-47; col.9, lines 10-18). Thus, the PE's above statement: "....an intermediate product of aluminum oxyfluoride would form prior to the formation of aluminum fluoride" is not supported by either Payne's scientific analytical data or this applicant's experimental evidence.

For an aluminum hydroxide fluoride hydrate precipitate to convert to an aluminum oxy-fluoride during calcination, the precipitate must be calcined in either an air or oxygen atmosphere at high temperatures; generally greater than 900°C.

For an aluminum hydroxide fluoride hydrate precipitate to convert to an aluminum fluoride during calcination, the precipitate must be calcined in a non-oxidizing atmosphere (see ABSTRACT) at low temperatures; ca. 566°C (1050°F), (col. 9, line 14).

2. PE: "Payne differs in that the taught calcining of aluminum hydroxide fluoride to form aluminum fluoride does not teach that aluminum oxide is also formed."

Applicant: The PE is correct, Payne "does not teach that aluminum oxide is also formed" because aluminum oxide (alumina) is not a "formed" product, but rather, a carryover of unreacted (reactant) alumina. Commercial grade alumina that has "a loss of weight on ignition of from 0.5% to 2.5%" (col.5, lines 35-37) is an excess reactant used to ensure the efficacy of Payne's process. For the alumina reactant, Payne preferred "to use a weight ratio of alumina to theoretical aluminum fluoride of between about 1:1 and 5:1, i.e., about 3:1"(col.6, lines 7-15). "The filtered precipitate unavoidably [unavoidably] contains all of the unreacted alumina added to the reaction solution" (col.6, lines 25-27).

The carryover, unreacted (reactant) alumina indicates that all or most of the fluoride ions in solution are chemically bonded to the alumina hydrate ions and form an aluminum hydroxide fluoride hydrate precipitate; with "the fluoride content of solutions containing as little as about 0.02% fluoride" (col.1, lines 58-60). During calcination, from about 400 to 620°C, the hydrate precipitate chemically decomposes to an end product mixture of aluminum fluoride ( $\text{AlF}_3$ ) and unreacted aluminum oxide ( $\text{Al}_2\text{O}_3$ ) (col.10, lines 3-5). In Example II (col.9, lines 17-18), "about 14.9g. aluminum oxide and 2.8g. aluminum fluoride" was the quantitative product-mixture; note the 5.2 to 1.0 ( $14.9\text{g. Al}_2\text{O}_3 \div 2.8\text{g. AlF}_3$ ) weight ratio.

U.S. Patent 5,558,847 – Henning Kaaber  
PROCESS FOR RECOVERING ALUMINUM AND FLUORINE FROM  
FLUORINE CONTAINING WASTE MATERIALS - Sep. 24, 1996

3. PE: "Kaaber teaches that when aluminum hydroxide fluoride is calcined it forms aluminum fluoride and aluminum oxide (see the abstract)."

"It would have been obvious to one of ordinary skill in the art to form aluminum oxide in the process of Payne when the aluminum hydroxide fluoride is calcined because that is what Kaaber teaches in a similar calcinations process."

Applicant: As stated above, the **only new formed** end product produced by the Payne process was aluminum fluoride. The aluminum oxide identified in the calcined product-mixture was **unreacted** (reactant) aluminum oxide; as verified by chemical and X-ray analyses (col.6, lines 28-37 and lines 44-47; col.9, lines 10-18).

Kaaber, unlike Payne, actually formed aluminum oxide as an end product. This occurred because he used several forms of aluminum as reactants that are soluble in acid; these were aluminum metal, aluminum hydroxide,  $\text{Al}_2\text{O}_3$  very slightly soluble in acid or aluminum sulfate. In solution and upon calcinations (ca. 556°C), these aluminum forms converted, chemically, to aluminum oxide.

This applicant can only suggest the following sentence as to why Kaaber chose not use the "Calcined Bayer process anhydrous alumina" (commercial grade alumina) that Payne chose (col.3. lines 39-41) in his process. Assuming all of Payne's and Kaaber's (P&K) processing conditions were equal, it appears that Kaaber's process is capable of recovering two to three times larger quantities of aluminum fluoride per run than Payne's process.

### General Chemical Information Pertaining To The Patents

When water and fluoride ions are mixed, an aqueous hydrogen fluoride [HF (aq)] solution is formed. The pH acidity of the HF (aq) solution is a function of the fluoride ions' concentration. An HF (aq) solution is the fundamental reactant of this applicant's generic process to produce refractory oxides; as noted in the specification (see pp. 1,6,7,9,14,16, 21, 23 and 24). For well over a century, probably countless chemical processes have used aqueous hydrogen fluoride solutions.

For any process whose mixed reactants are water, fluoride ions and either most metals or metal oxides, the initial chemical reaction, at low temperatures, is the formation of a metal hydroxide fluoride hydrate precipitated compound. It is; therefore, not chemically extraordinary, within a low temperatures range of ca. 60 to 150°C, that all three processes (Payne, Kaaber and Dugger) initially formed varied molar concentrations of aluminum hydroxide fluoride hydrate precipitated compounds. Neither Payne's nor Kaaber's patent granted him a limited monopoly on the overall named chemical composition: "aluminum hydroxide fluoride hydrate precipitated compound;" if so, of the two, only Payne, because of his earlier filing date, would have been awarded a patent.

Thus, Payne's and Kaaber's patents were awarded because of novel processes they used to produce the aluminum hydroxide fluoride hydrate precipitated compound. Their claims; therefore, are process claims. Similarly, this applicant's Divisional Application claim(s) also are process claims. Neither Payne's nor Kaaber's process claims invalidates this applicant's process claim(s) as obvious and unpatentable; because Payne's and Kaaber's (P&K) processing conditions and chemical reactions, for example, can not produce this applicant's visible region's transparent end products. More differences are given immediately below.

### MAJOR CHEMICAL AND PHYSICAL END PRODUCT DIFFERENCES BETWEEN P&K PROCESSES AND DUGGER'S PROCESS

Again, within a low temperatures range of ca. 60 to 150°C, all of the processes (Payne, Kaaber and Dugger) form varied molar concentrations of aluminum hydroxide fluoride hydrate precipitated compounds. When Payne's and Kaaber's (P&K) precipitated compounds are calcined in a non-oxidizing atmosphere, within a temperature range of 400 to 620 °C, an aluminum fluoride compound is produced. Thus, Payne's and Kaaber's desired aluminum fluoride end product compounds and processes are similar. When the an aluminum hydroxide fluoride hydrate precipitated compound is calcined in an oxidizing atmosphere at temperatures ca. 900 °C and higher, Dugger's aluminum oxyfluoride intermediate product compound is produced. When this compound is further calcined above ca. 1200 °C in an oxidizing atmosphere, the aluminum oxyfluoride chemically decomposes to a desired transparent aluminum oxide end product.

In summary, P&K processes differ chemically and physically from Dugger's process to produce their above respective end products because: (1) Unlike the Dugger process, the P&K processes are not generic processes for producing refractory oxides; (2.) P&K and Dugger's chemical reactions are different; except for the initial chemical reaction that produces the precipitated compounds, common to all three processes; (3) P&K and Dugger's calcinations atmospheres are different; (4) P&K and Dugger's calcination temperatures are different; (5) P&K and Dugger's chemical end products are different; (6) Unlike Dugger's end products, neither Payne's nor Kaaber's end product exhibits optical-grade transparency, an extremely important capability and improvement in the manufacture of refractory oxides. Consequently, this applicant's process is not obvious and unpatentable because of Payne's and Kaaber's processes.

Because of E.P.A.'s laws, P&K goals and objectives are to safely recover effluent fluoride gases resulting from the production of aluminum metal. Dugger's goals and objectives of this Divisional Application are to produce, generically, transparent or opaque refractory oxides at reduced temperatures; significantly below their natural melting points. Thus, Payne's and Kaaber's goals, objectives and processes are significantly different from Dugger's goals, objectives and process.

Respectfully submitted,



Cortland O. Dugger  
12600 Westover Court  
Upper Marlboro, MD 20772-5036  
(301) 627-5268

Dated: October 14, 2003